SCIENCE:

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JOHN MICHELS, Editor.

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SATURDAY, NOVEMBER 12, 1881.

The distribution of honors at the French Electrical Exhibition is very gratifying to the pride of the American people, as the American exhibitors have relatively carried off a large share of the prizes.

Edison has maintained the prestige of his country, and asserted the integrity and value of his wonderful series of electrical inventions, by *alone* receiving a "diploma of honor" for the electric light. This high mark of distinction he shared in other departments with the United States Signal Office, the Smithsonian Institution, the United States Patent Office, and Messrs. Graham & Bell.

Gold medals were awarded to the Anglo-American and Brush Electric Light Companies, the United States Electric Lighting Company, Elisha Gray and Taintor. Silver medals to Bailey & Puskas, Conolly Brothers & MacTighe, Dolbear, Eccard, Electric Purifier Company, Hubbard Pond Indicator Company, Western Electric Manufacturing Company, Western Electric Light Company and the Electro-Dynamic Company. Bronze medals to Messrs. Chavat, Cumming and Dion, the Hoosac Tunnel Company, the Trinitro Glycerine Works, Partz, Photo-Relievo Company, Whitehouse, Mills & Williams.

That Mr. Edison, with the whole world competing, and with every system represented, should receive from such a critical committee this special recognition and honor, as the inventor of the most perfect system of electrical illumination, appears to decide this point in a decisive manner. The practical application of this system on a scale which will astonish the world, is near at hand. The immense dynamo machines designed for use to illuminate a district in New York City with Mr. Edison's perfected lamps have been placed in position, and the mass of details connected with placing wires and fittings are nearing completion. Soon the word will be given that all is ready, and Mr. Edison will probably enjoy a triumph to which all his previous successes will be insignificant.

Mr. Edison must experience some regret that he was unable to be present at Paris, and in person receive the congratulations which would have been showered upon him, but we understand that he was most worthily represented by Mr. Charles Batcheler and Mr. Otto Moses, whose courtesy and indefatigable exertions have been fully recognized in some of our Parisian exchanges.

AN instrument was lately described in a French journal, which was invented for the purpose of detecting oleomargarine as against pure butter.

This instrument discriminated between the specific gravities of the two substances. Shortly after the announcement of the making of this instrument, a report was spread in the daily papers, that the slight difference of density between oleomargarine and butter, was insufficient for this purpose.

A correspondent writes as follows on this subject: "The report that no difference of density is of any use in distinguishing oleomargarine from butter, is very easily disposed of, as the density of oleomargarine is 0.915 and the density of butter is 0.925. One will float at 15 C. in alcohol $53\frac{3}{4}$ per cent., and the other in alcohol $59\frac{1}{4}$ per cent. I mean by floating that the butter or oleomargarine will neither rise nor sink, when placed in the alcohol. If placed in the middle it will neither go to the top nor bottom, except very slowly. Of course there are persons who cannot distinguish between 0.915 and 0.925 specific gravities, and who cannot make an observation at a fixed temperature, but it is unreasonable to expect that any process can be satisfactory to such persons."

SCIENTIFIC ASSOCIATIONS IN WASHINGTON.

The three societies at the metropolis, the Philosophical, the Anthropological, and the Biological, all reorganized in October under very favorable auspices. A short account of their proceedings is given below:

PHILOSOPHICAL SOCIETY OF WASHINGTON.—Three papers were read, one on Geology, by G. K. Gilbert, which our correspondent did not hear; a communication on Fog-signals, by Prof. Johnson, of the Light-house Board, and a paper on the Best Methods of Calculating the Solar Parallax, by Professor Harkness, of the National Observatory. Mr. Johnson's remarks were an account of investigations made the last summer upon the refractions of sound, in pursuance of the experiments set on foot by Professor Henry. The inquiries were prosecuted mainly in Newport harbor and its vicinity. The facts set forth were of great interest to scientific men and of great practical value to the mariner. Professor Harkness, who is a very ready speaker, gave the Society an explanation of the various methods employed in calculating the distance of the sun and the planets, inclining to prefer the transit observations as yielding the best

results. Professor Harkness has great hopes of photography as an auxiliary in this direction.

THE ANTHROPOLOGICAL SOCIETY.—Four papers were read in October, all of them mythological and all of permanent value, to wit: the Buffalo Woman: an Omaha Myth, by the Rev. Owen Dorsey; Myths of the Wintuns, by Major J. W. Powell; the Stone God of the Putepemni, by the Rev. S. D. Hurman; and the Dangers of Symbolic Interpretations, by Col. Gerrick Mallery. It is impossible to give an abstract of a myth. We can only say that Major Powell years ago conceived the idea of studying myths by the Baconian method. He told the writer of this sketch, "there are books and books on mythology, but very few myths. I will collect a volume of well authenticated myths, from which mythologic philosophy can be deduced." The Major has himself gathered a great number, and Messrs. Dorsey and Hurman were for many years missionaries among the Dakotas, speaking their language with the greatest freedom. Our readers will be pained to hear that Major Powell has been confined for several weeks by an acute attack of iritis. Colonel Mallery's paper was a thoughtful treatment of the subject of symbolism, neatly considered in its threefold aspect of signs, emblems, and symbols. The North American Indians north of Mexico had not arrived at that psychologic stage wherein true symbolism manifests itself.

THE BIOLOGICAL SOCIETY OF WASHINGTON.—The opening meeting of the Biological occurred on the evening when the city was all excitement over the reception of our French and German guests. The session of Friday, October 28th, however, was one of considerable interest. Professor Lester F. Ward exhibited an example from the petrified forests of Wyoming, mimicking the paw of an animal, which elicited a discussion as to the formation of agates and other minerals of that character.

Mr. Henry Elliot's communication on the biology of the Sea-Otter was very instructive. Little is known of the habit of this animal, the stuffed specimens in the museums conveying a very poor notion of its form. It is supposed to breed on the great beds of kelp which float in the northern seas, having one pup at a birth. Its fur is a hundred times more valuable than all other fur products combined. The hunting is especially dangerous and requires great skill.

Professor Thomas Taylor exhibited and described a freezing microtome, in which the cooling effect of a current of water from salt and ice is used to produce the hardening. The extreme cheapness, simplicity, and practicability of this apparatus will enable the microscopist to dispense with the more costly and difficult methods hitherto used for obtaining thin sections of tissues and for examining the brain and other soft parts of the body in a rigid condition.

THE EVOLUTION OF FLYING ANIMALS.

By CHARLES MORRIS.

There are some questions in Biological science which it will be difficult, if not impossible, to settle by an appeal to facts, and in the investigation of which we are obliged to employ a degree of speculation. Thus we have abundant reason to believe that birds are direct derivatives from reptiles. We know, in fact, that these animals resemble each other in such essential particulars as to justify the grouping of them together in a single vertebrate section, the Sauropsidæ of Huxley. We can even trace, by aid of the palæontological record, some of the steps by which birds arose from their reptilian progenitors. And yet no definite hypothesis has been advanced as to how the scales of the reptile became the feathers of the bird, how the quadrupedal habit of the one became the bipedal habit of the other, or how the walking changed to the flying method of locomotion.

These questions we cannot now, and perhaps may never be able to, answer with the argument of facts. But if some probable mode by which such variations may have arisen can be suggested, the speculation will hardly be an empty one. All the great theories of science have simply the force of highly probable speculations, based on known facts; and lesser theories, if given the same basis, may prove equally desirable.

One of the most striking features in animal life is its tendency to spread outwards, functionally, in every possible direction, so as to occupy each field of nature in every advantageous manner. One-half of the animal world seeks to feed on the other half, while this second half seeks to escape being fed upon. This is one of the main elements of natural selection. Every change in organization that proves an advantage to the carnivorous animal in assailing his prey, is apt to be retained. Every change that aids his prey in escaping is likewise retained. Through this cause there have been continual variations, since every favorable change in the one class would prove injurious to the other class, unless met by an equal counter change.

In this long continued process of adaptation to circumstances, every advantage offered by water and land to their animal inhabitants, in overcoming their prey, or in escaping from their enemies, has been long since adopted, and an immense variety of animal forms has arisen in consequence. But the air also presents favorable conditions both for escape and pursuit, and the adaptation of animals to aerial flight is so obviously advantageous, that it must have arisen as soon as the developing organization of animal life, and the occurrence of the necessary terrestrial conditions, rendered it possible.

In considering the problem of how flight originated, it will be desirable to take up successively the three questions above given. First, how did scales become feathers? The three higher classes of vertebrate animals have each its peculiar dermal covering. The Reptile has its bony plates, or its scales, the Mammal its hairs, and the Bird its feathers. Scales, hairs, and feathers are alike in origin, and are but specialized forms of a similar epithelial outgrowth. Yet these three classes of animals seldom invade each other's province. No reptile has a hairy or feathery coating. If mammals and birds were evolved from reptilian progenitors, the change of scales into hairs and feathers forms one of the processes of this evolution, and should be explicable under the natural selection hypothesis.

Certainly reptiles never became feathered through the Lamarckian process. No effort to fly, however vigorous, could have converted the scale of the reptile into the feather of the bird. It would be useless for flight until it had become almost a perfect feather, and therefore there could be no moulding influence upon its intermediate stages. The rudimentary feather must have arisen under the pressure of some other influence, and its adaptation to flight must have been a secondary resultant.

If we ask, what is the rudimentary feather, we seem to find it in the hair. In the larger land birds, as the Ostrich, the feathers on some parts of the body are indistinguishable from hairs; and in the tails of flying-squirrels the hairs spread out in a manner that seems preliminary to a development into the feathery condition. We may begin by asking, then, through what process of natural selection did the scale develop into the hair?

In seeking to solve this problem we first ask, what advantage has the hair over the scale as a dermal covering? The only positive answer we can make to this is, that it has greater warmth. It enables the haired animals to endure degrees of cold which would be fatal to the scaled animals. This difference in covering has a marked effect on the lives of the two classes of animals. Through the wide possibilities of increase in length and thickness of their hairy coat, mammals can endure the

greatest extremes of winter temperature, while reptiles are strictly summer animals, those inhabiting the colder zones being forced to hibernate during the winter. Existing reptiles, then, have no need of a warmer covering than they possess. Their localities and life habits render this sufficient to protect them from all the changes of temperature to which they are exposed during their period of activity. But if the possession of a hairy covering would have enabled the reptiles of the past to remain active throughout the whole year in cold climates, why was it not developed? The answer is that it would have been of no special advantage to them. They are otherwise unfitted for activity during the season of low temperature, and to adapt them to this condition, not only their outer covering needed to be modified, but their internal organization as well. This change in organization has taken place in many cases, and with it the development of a warmer covering than the reptilian coat. But the reptile, thus modified, has lost its reptilian character. It has, in the one case, with other less important changes, become a bird; in the other case, with other more important changes, it has become a mammal.

The change in internal organization referred to is that in the circulating system. The imperfect heart, the sack-like lung, and the half-ærated blood of the reptile have developed into the perfect heart, the unlike but widely-extended lungs, and the fully ærated blood of the mammal and the bird. The varying temperature of the reptile is exchanged for the unvarying temperature of his successors. The so-called cold-blooded reptile, with its insufficient oxygenating organs, is at a disadvantage as compared with the bird and the mammal, with their fully oxygenated blood.

To bodily activity is necessary an internal temperature sufficiently high to render the organic chemistry of the body active. In the temperature of the tropics, and the summer temperature of the extra tropical zones, all animals possess this temperature, and none are at a disadvantage in this particular. But the reptile depends directly on the solar heat for its temperature, the bird and the mammal do not. Thus when the temperature falls the internal temperature of the reptile similarly decreases, its organic chemical change declines in activity, it becomes sluggish in movement, unable to obtain food, and would perish but for the hibernating habit which is customary with it. But the bird and the mammal preserve the temperature essential to organic chemical activity. They continue, therefore, awake and energetic, and in a condition to obtain the necessary food-supply.

The reptile is essentially a tropical animal. Its organization unfits it for the extremes of extra tropical temperature, and it is active in the temperate and frigid zones only during the tropic heat of their summers, but conceals itself and continues torpid during the cold of their winters.

Birds and mammals are essentially adapted to a life in the colder zones. They must have originated in regions in which wintry cold, for some part of the year, replaced the summer heat. The reptilian circulation sufficed for the needs of animals bathed in a fixed degree of external heat, high enough to promote their bodily activity. But animals exposed to severe cold during any portion of the year must either hibernate during that period, or must gain an improved circulation. The heat which fails them without must be produced within, or their activity must cease.

This is what we must understand from the systems of circulation of the bird and the mammal. Their reptilian progenitors slowly gained more complex lungs with an increased ærating surface; the blood became more fully oxygenated; the arterial and venous blood became more completely separated in the chambers of the heart; and as a natural result the internal temperature increased. Such slight changes could not have been preserved and augmented unless of advantage. They would have been of no special advantage to the tropical animal. To the animal of the temperate zones they were decidedly advantageous, in enabling it to remain active during a greater portion of the year, and finally during the whole year, the internal stores of heat replacing the lost external stores when winter replaced summer.

But these internal stores must not only be produced, but must be retained. A heat-retaining covering is necessary to hinder the chilling effect of the wintry air. The reptilian scale is obviously not sufficient for this purpose. As the internal heat of the animal increased, and it was able to prolong its period of active life more and more into the cold season, some modification of the scale became necessary, so as to make it more efficient in retaining this internal heat. The scales may, from their points of origin, have grown out longitudinally, covering each other in successive layers, and thus forming a warmer and closer covering. Such a process of elongation, if accompanied by a narrowing of the individual points of origin, would, in time, convert the the scale into a hair. It is well known that they are capable of becoming so converted, by such an elongating outgrowth.

Thus the haired and feathered animals could not have arisen until the possibly general summer of early times was replaced by a double season of summer and winter in the extra tropical regions. But though thus of temperate origin, there was nothing to hinder their spreading both into the frigid and the tropic zones. Their improved circulation gave them an activity superior to that of the preceding reptilian rulers of the tropics, and they thus had an advantage in the life battle, which soon showed its effects. The giant reptiles disappeared and giant mammals took their place. Gradually the reptiles retreated before the march of the mammals. They sank to the ground, hid in holes, learned to creep, to squirm, to swim, while their mammalian successors proudly stalked over their conquered realm, the lords of the earth.

If this, through the advantage gained by adaptation to wintry cold, animals were evolved possessed of a perfect circulation, a fixed internal temperature, and a poorly conducting external covering of hair; and if these animals, through their improved powers, banished their reptilian predecessors, or forced them to retreat to the waters, the holes, and the dark recesses of the earth; it remains to consider the subsequent variations of these hair covered animals; or, at least, of the flying sections of these creatures.

The next question to be considered is that of the change from a quadrupedal to a bipedal habit of motion. There is only one true biped among the whole great class of mammals, namely, man. He is approached in this bipedal habit by the higher apes, and it is not difficult to understand how the specialization of limbs took place in the latter. It undoubtedly arose from the climbing habits of monkeys. The fore limbs became used as grasping organs, the hind limbs as supporting organs. As climbing monkeys increased in size, they must in many cases have moved by grasping upper branches with their hands, and supporting their feet on lower branches. This was an imperfect bipedal movement. Eventually some of them became too heavy to render a continual arboreal residence desirable. These came to spend the most of their lives upon the earth, as we find in the larger apes of the present day. But these apes are neither quadrupeds nor bipeds. The specialization of their limbs during a long arboreal residence has unfitted them for either mode of motion upon the ground, and they move along in an awkward and inefficient compromise between the two modes of motion. Evidently the method of progression of these animals is not a desirable one for a land residence. Natural selection must tend to make them full quadrupeds or full bipeds. Those of them which have recently changed their arboreal for a ground habitat, have not had time to change. Those which earlier descended to the earth have

evolved improved methods of progression. The most of them have returned to the quadrupedal condition, if we may conceive the four-footed baboons to have arisen in this manner. As to whether any of them have gained the perfected bipedal condition, it is perhaps best to make no assertion. Those who hold that man had an ape-like progenitor, must accept this view.

There are other mammals with partially bipedal habits. These compromise the jumping animals, the kangaroos, jerboas, etc. But in these cases there has been no specialization of the fore-limbs. They have simply become partly aborted. The bear also, through its plantigrade feet, and perhaps its climbing habit, has gained imperfect bipedal powers, and a grasping habit with its fore limbs. But there has been no specialization of these limbs. They continue true walking organs.

In the reptilian world other instances of bipedal habits present themselves, developed in still another manner.

The animals thus organized are all creatures of a vanished age—the huge Deinosaurian reptiles presented to us in the geological record. These creatures may have gained their specialization of form through the same cause, though not in the same manner, as the giraffe gained its special formation. Many of them lived by browsing on the foliage of trees. And these, instead of developing an elongated neck, like the giraffe, probably obtained their food by a partially climbing process. Their fore limbs clasped the tree trunk, while their weight rested on the hind limbs and the tail. In this manner they were able to reach the desired food.

A long continuance of such habits would produce, through selection, a specialization of the fore limbs. To become efficient organs for grasping tree trunks, they must have become inefficient walking organs. Through this specialization the fore limbs seem to have become small and comparatively weak, the hind limbs large and powerful. To look at the remains of these creatures now, as preserved for us in the rock strata, it seems as if a quadrupedal motion must have been very awkward and inefficient; while their habit of erecting themselves on their hind legs, may have rendered a bipedal motion easy and natural. Professor E. D. Cope says of them: " some have chiefly squatted, some leaped on their hind legs like the kangaroo, some stalked on erect legs like the great birds, with their small arms hanging uselessly by their sides." Yet when we consider the great size of these reptiles, which comprise the huge Iguanodon and Megalosaurus, the Hadrosaurus of our New Jersey marl, and other such gigantic creatures, we may well imagine that they presented an appearance widely different from that of any existing creatures. To see animals thirty feet in height and huge in proportion, to whom our elephant would be a mere pigmy, stalking about erect on their hind legs, would certainly be an astonishing spectacle. Yet such a view was very probably presented by that bizarre world of the past which time has swept away.

These Deinosaurian reptiles, with their peculiarities of structure, their hollow bones, and their three-toed feet, presented certain strong affinities to the great land birds of modern times. So close, indeed, that some have conjectured that these large wingless birds, such as the Ostrich, are direct descendants of the Deinosaurs. In this claim there are no powers of flight to be explained, yet the possession of feathers by the ostrich seems a fatal obstacle to the hypothesis. Feathers are a highly specialized form of dermal covering. They are specially adapted to purposes of flight, and we can imagine for them no other use which the less specialized hairs or scales would not have subserved. We are therefore disposed to conclude that any animals possessed of feathers must have gained them through powers of flight in themselves or their ancestors; and that the resemblances in organization above mentioned arose from similarity in modes of progression, and not from hereditary connection.

How, then, was the further step in the process taken? The primitive hairy covering being gained, how did hairs develop into feathers, how were the imperfect bipeds among land animals succeeded by the perfect bipeds among flying animals, and how did motion upon the earth develop into motion through the air? It certainly did not arise as a result of leaping habits. We cannot imagine the spring of a kangaroo as so advantageously aided by an accidental conformation of the fore limbs, as to produce a natural selection of this conformation. If these leaping animals habitually sought to assist their flight by a motion of the fore limbs, then any membraneous expansion or special thickness of hairy covering would be advantageous. But none of those now existing have such a habit, and without it their leap could never become a flight.

(To be continued.)

THE NEW COMPRESSED AIR LOCOMOTIVE.

On the 13th ultimo a trial of a new engine built by the Baldwin Works, Philadelphia, took place on the Second Avenue Railroad, the result of the trial being on the whole satisfactory. Compressed air as a motive power for railway engines has been repeatedly tried already in this country and in Europe. At Paris and Nantes the Mekarski Air Engine has at different times been used with more or less success, at Glasgow. Mr. Scott Moncrieff has labored perseveringly to demonstrate the superiority of compressed air over steam for locomotive purposes, while in June last year Col. Beaumont produced (in London) an engine which was thought at the time to have eclipsed its predecessors in point of efficiency and small working cost. The "success," however, of these engines has been so very undecided, and the advantages they presented in point of cleanliness, and absence of smoke and noise, have been so counterbalanced by the cost of compressing and storing the air, that as yet we have heard of no line of railroad or tramway being *successfully* worked by compressed air.

Comparing the data obtainable from these engines with the result of the late trial, we find a decided superiority in the efficiency of the American engine which possesses several new and important features, and is the result of long experience and study of the subject by the inventor and patentee, Mr. Thos. Hardie, the Pneumatic Company's Chief Engineer.

A short description of the engine and its trial may not be uninteresting to our readers. In length and weight it is as nearly as possible the same as an average Elevated Railroad engine, the part usually reserved for the boiler being in this case occupied by the receivers for containing the air, four in number and of unequal lengths, having an aggregate capacity of 460 cubic feet, in which air is stored at a pressure of 600 lbs. per square inch. Inside the cab is a small boiler (the consumption of coal in which is nominal) through which air from the receivers is passed before being allowed to enter the cylinders. An automatic throttle valve on the supply pipe of this boiler regulates the pressure at which the cold air enters the boiling water. The air being thus heated expands and the pressure is of course considerably augmented, and in this hot, moist condition it passes into the cylinders, having a far larger percentage of efficiency than if it were allowed to do so in a cold, dry condition. There is thus by this means a great saving in the quantity of air consumed. The system of drawing air from the reservoir at a low pressure and expanding it by heat until it attains a working pressure of from 100 to 130 lbs. per square inch is, we believe, entirely novel, and in this respect the engine differs altogether from Col. Beaumont's machine, in which air was admitted to the cylinders at its initial reservoir pressure—1000 lbs., and then quickly cut off.

In a former engine built by the Pneumatic Company

the air, instead of being heated by a small boiler, was made to pass through a tank which was supplied at intervals with boiling water and recharged as soon as the water cooled. The present arrangement is the result of experience derived from its predecessor.

The valve gear is simple and is fitted with a variable expansion valve under the control of the engineer, by which the cut-off can be varied from 1-10th to 5-8ths of the stroke. The link is worked by "crossed" eccentric rods, the effect of this being to prevent *any* opening of the parts when the reversing lever stands in the middle notch. By this arrangement the cylinders are, when necessary, converted into vacuum pumps and are utilized to operate the vacuum brakes attached to the cars. It has been found that when using the air expansively while running, *i. e.*, with a quick "cut-off," the expansion is sometimes so rapid that towards the end of the stroke the pressure in the cylinders is less than the external atmosphere; to obviate the loss of power which would be caused by the vacuum thus created, valves are placed in the exhaust passages, which prevent any vacuum being formed. Another feature in the engine is the existence of a suction and delivery valve at each end of both cylinders, which render it possible when going down hill, or approaching a station, to convert the cylinders themselves into "compressors," by which the pressure in the reservoirs can be increased, thus utilizing the waste energy which is usually given off in friction against the brakes. This arrangement is so successful that no other brakes are required on the engine. There are several minor points in the construction of the machine which it is not necessary to mention here; we may, however, say in conclusion that the engine has been carefully studied in every detail.

At the trial, the engine started from 128th street with a pressure in the reservoirs of 580 lbs. per inch, and travelled as far as 42nd street, a distance of 4½ miles or thereabouts, stopping at every station, and loaded with three cars containing about 50 people. At 42nd street some switching was done, and the engine then returned to the starting place, reaching 128th street with a remaining pressure of 115 lbs.

These figures show that the train would have run from Harlem to South Ferry, the entire route of the Elevated Road. But in making any practical calculation, it must be remembered that four cars are often used instead of three, and that these four cars would often be loaded with 600 persons. This probably implies an additional weight of about thirty tons to that placed behind the Pheumatic Engine during the recent experiment.

The company must be congratulated on building a most successful engine.

UNIVERSAL ENERGY OF LIGHT.*

By Pliny Earle Chase, LL. D.,
Professor of Philosophy in Haverford College.

Force is generally regarded as a function of mass and velocity. The greatest known velocities which can be produced by central forces are wave velocities. The greatest known wave-velocity which appears to be universally diffused is the velocity of light.

Let $v\lambda$ = velocity of light; v_0=circular-orbital velocity at sun's surface $=\sqrt{g_0 r_0}$; v_3=Earth's mean orbital velocity; v_r = velocity of Sun's equatorial rotation; u_3= potential velocity of water at 0°C. $=\sqrt{2g \times 100 \times 1389.6}$ ft.; u_4 = potential velocity of water at its maximum density; u_5=potential velocity of water-evaporation= $\sqrt{2g \times 536.37 \times 1389.6}$ ft.; m_0, m_3, m_5, m_6=masses of Sun, Earth, Jupiter, Saturn; h_0=Earth's semi-axis major; h_2=height of mean oscillatory projection due to the combining energy of H_2O; t_a=time of acquiring circular-orbital velocity at Laplace's limit of synchronous rotation and revolution = time of rotation $\div 2\pi$; t_n = time of acquiring "nascent" or dissociative velocity at nucleal surface = ½ time of rotation $=\pi t_a$; χ=Weber's electrochemical unit; μ=electromagnetic unit; ρ_0=total magnetic force; ρ_3=terrestrial magnetic force; t_0=present value of t_n at Sun's surface; g_0=gravitating acceleration at sun's surface.

The simplicity of the relations of the universal velocity $v\lambda$ to other physical velocities, is shown in the following equations:

$$1.\quad \frac{v\lambda}{u_3} = \frac{h_0}{h_2} = \frac{m_0}{m_3} = \frac{t_n^2}{t_a} \cdot \sqrt{\frac{\rho_0}{\rho_3}}$$

$$2.\quad \frac{v\lambda}{v_0} = \frac{v^0}{u_4} \cdot \sqrt{2} = \frac{t_n}{t_a} \cdot \frac{v_0}{v_r}$$

$$3.\quad \frac{v\lambda}{g_0} = t_0$$

$$4.\quad \frac{v\lambda}{v_3} = \sqrt{\frac{m_0 m_5}{m_3}} = \frac{m_0 t_a}{m_3 t_n} \cdot \sqrt{\frac{\mu}{\chi}}$$

$$5.\quad \frac{v_5}{u_5} = \frac{3^4 m_0}{2 m_6} = \frac{5 \times 3^3 m_0}{m_5}$$

The velocity of solar atmospheric rotation, at the secular mean centre of gravity of the solar system, is also equivalent to u_5.

The law of conservation of areas, in an expanding or contracting nucleus, requires that g_0 should vary inversely as t_0. Equation 3 should, therefore, hold good for all stages of solar existence, past, present and future.

The values which satisfy the above equations are: m_0=328470 m_3; h_0=92476500 miles; $v\lambda$ = 185760 miles; v_3=18.412 miles; u_3=2986 ft.; u_5=6916.2 ft.

The following table shows the accordance between theoretical and observed values:

	Theoretical.	Observed.
Boiling point of water........	99°.18	100°
Combining heat of H_2O.......	69319	67616 to 69584*
ρ_6...........................	140.65	140 lb. pr. sq. in.
Maximum density of water....	4°.19	3°.33 to 4°.85
v_3...........................	18.31	18.41
Latent heat of steam..........	536°.374	536°.385 †
$\chi \div \mu$........................	107.38	106.67

The velocity of light is also a factor of electromotive energy. Weber and Kohlrausch demonstrated this fact by measuring quantity of electricity; Thomson and Maxwell, by measuring electromotive force; Ayrton and Perry, by measuring electrostatic capacity.

Perhaps the most interesting of the above indications is the past, present and future equivalence of Sun's "nascent" velocity to the velocity of light; the sum of the cyclical reactions of solar superficial gravitation against the actions of external gravitation, during each half-rotation, being *equivalent to the velocity of light.*

The Metal Actinium, by J. L. Phipson. — The author stated that he had been able to separate a new element from the pigment zinc-white. The oxide of the new element is said to be slightly soluble in caustic soda, and is soluble in ammonia and ammoniacal salts. Its color is uninfluenced by exposure to light. The sulphide of actinium is described as a pale yellow canary-colored substance; it is insoluble in ammonium sulphide, is soluble in acetic acid, and becomes darker on exposure to the air.—*British Association*, 1881.

* Read before the American Association for the Advancement of Science, August, 1881.

* The mean of six estimates, cited by Naumann, is 68886.

† This is the mean of four estimates, viz.: Favre and Silbermann, 535°.77; Andrews, 535°.90; Regnault, 536°.67; Tyndall, 537°.20.

THE ELECTRIC EXPOSITION.

THE ELECTRIC LIGHT.

THE GENERATORS.

The Palace of Industry offers to the world a unique collection of apparatus for producing the electric light.

The problem seems to be solved, if we can judge by the multiplicity of the solutions proposed; we shall see in the sequel that it is not yet completely solved, but this same multiplicity sets out well in relief the incomparable elasticity of electricity applied to light, and shows that it is possible from this day to introduce the electric light in all applications; by giving to it, in each particular case, the special qualities which assure its superiority over other systems, under the limitation of two conditions which we shall treat separately: economy and the distribution of electricity.

We shall rapidly examine the processes of generating electricity for the special purpose of light; a following article will be devoted to lights, regulators, and incandescent lamps.

Three methods are known of generating electricity in quantity sufficient for the electric light: hydro-electric piles, thermo-electric piles, and electro-dynamic machines.

In this Exposition there is no thermo-electric pile applied to light. Some years ago we had hoped that M. Clamond would have continued his work in thermo-electricity, but he has, unfortunately, done nothing, and we can only express our regrets in this respect.

The piles intended for the electric light are represented at the Exposition but by two types: the pile of M. Cloris Baudet and that of M. Tommasi.

The pile of M. Cloris Baudet is a pile with bichromate of potash; with five elements, of which, according to the inventor, only one a day needs to be replaced, the pile can sustain a voltaic arc, with carbons of three millimetres, whose power is about 15 Carcel burners.

The pile of M. Tommasi is a Bunsen pile. The improvements which have been applied to it do not appear fortunate to us, and we do not yet know of an application where it serves in a practical manner for domestic usage, as the prospectus pompously announces it. It is only necessary to approach for a moment the exposition of M. Tommasi, on the ground floor, in order to *feel*—in the proper and in the figurative sense—that the vapor of liberated hypoazotic acid makes the pile absolutely inapplicable to the usage for which it was primitively intended.

The instalment of this extensive apparatus and the manipulation which it requires, are, on the other hand, out of proportion with the result obtained.

Leaving aside these two separate cases, and the electric accumulators, to which we shall return, we can say that the electric light of the Palace is exclusively obtained from mechanical generators of electricity.

The motors which drive the electric machines demand a special study. They are of two kinds: steam and gas.

The Exposition contains several interesting types of motors especially intended to drive the electro-dynamic machines; we will cite among others the Brotherhood motor and the Dolgoronki rotative system motor. In these systems of motors of great rapidity, the driving shaft of the electric machine forms the prolongation of that of the motor; thus all intermediate transmission is done away with, but simplicity is purchased, it must be admitted, by a greater expenditure of steam.

The largest part of the motive force is produced by fixed, half-fixed, or movable machines varying from five to 150 horse-power. We do not say that the latter are most economic, because they consume, with equal power, much less of carbon, and because they have also a more regular motion—an essential condition for a good electric light.

We will notice more particularly two types of these powerful machines: one, exhibited by MM. Carels, is an expansion-engine, in a single cylinder; the other, exhibited by MM. Weyher and Richemond, belongs to the *compound* type, that is to say, with a compound cylinder; the expansion is made successively in the two cylinders. Figure 7 represents this motor driving the electric generators with alternate currents of Gramme and Lambotte-Lachaussée. The advantage of expansion-engines, either with one cylinder or with two conjugate cylinders, is great, for as soon as 100 horse-power is reached, less than a kilogramme of carbon is consumed each hour for every horse-power.

A large number of gas motors are also used to produce motive force. Most of them belong to the Otto type; they vary from 1 to 50 horse-power. The gas motors are practical enough, and also, up to a certain point, economical, when they serve to produce a light for a few hours each day, and in an intermittent manner.

For the same quantity of gas consumed, we can obtain 10 or 15 times more light by passing through the medium of the motor, the electric generator and the lamp, than by directly burning the gas in the ordinary burners, all in producing 100 or 150 times less heat in the light.

It is by an 8 horse-power gas motor that M. Jaspar drives the three Gramme machines which feed the three regulators placed in hall XV; a 50 horse-power gas motor also serves to light a part of the Palace.

We now come to the machines. We can first divide them, according to the generally admitted classification, into magneto-electric machines, of which the inductors are magnets, and into dynamo-electric machines, of which the inductors are electro-magnets.

The Exposition contains only two kinds of magneto-electric machines, the old type of Alliance and the machine of M. de Méritens. These machines are applied to beacon lights, and they also feed several Berjot regulators. Without wishing to condemn the electro-magnetic machines, it seems to be established, even by the Exposition, that their industrial reign has terminated. It must not be concluded by this that the electro-magnetic machines are worthless, but only that they are not industrial, in the practical sense of the word; that is to say, the power being equal, they are heavier, more expensive, and more encumbering than the electro-dynamic machines which are almost universally employed to-day.

In light-houses, where the question of capital engaged plays but a secondary role, the preference has been given to magneto-electric machines which, in consequence of the masses put in motion, give a greater relative regularity than electro-dynamic machines.

Magneto-electric machines, applied to light, are all with alternative currents.

Dynamo-electric machines are divided into two classes, according as they furnish alternative or continuous currents.

Machines with continuous currents.—The machines with continuous currents are suited to illumination by the voltaic arc and by incandescence. When they supply a single light they are mounted as represented in figure 1.

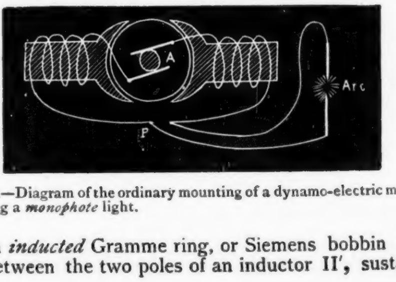


FIG. 1.—Diagram of the ordinary mounting of a dynamo-electric machine supplying a *monophote* light.

(A) an *inducted* Gramme ring, or Siemens bobbin turning between the two poles of an inductor II′, sustained

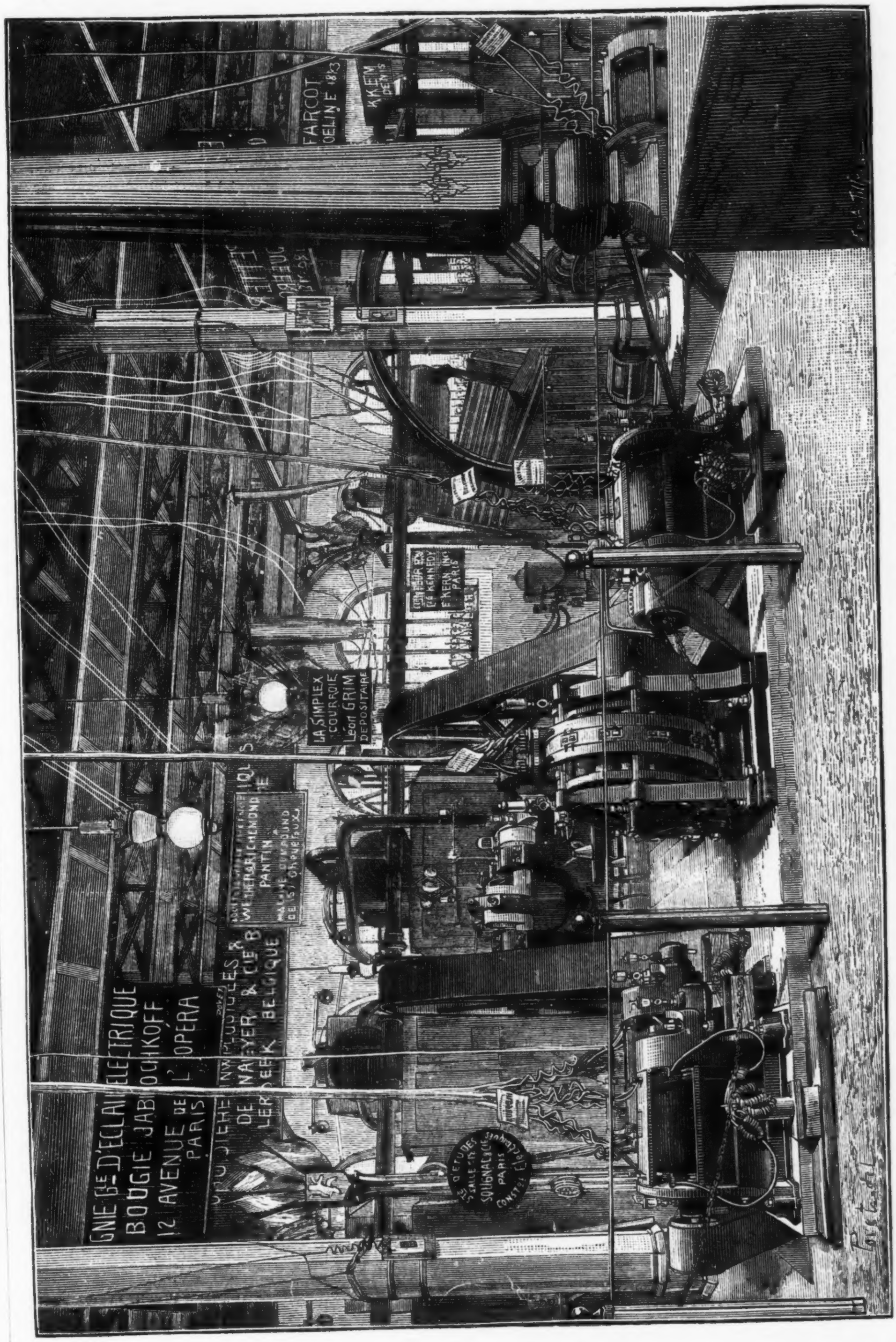


FIG. 7.—The Electric Generators of the Palace of Industry. International Exposition of Electricity. (After a photograph).

by the current from the bobbin, which also traverses the voltaic arc.

This is the mounting adopted to-day in most of the *monophote* regulators.

On examining this system a little closer, we see that it presents a serious inconvenience. When the arc is lengthened, the intensity of the current diminishes, for two reasons, first, in consequence of the increase of resistance of the current; second, because this enfeeblement corresponds to an enfeeblement in the same way of the power of the inductors, and, as a result, of the electro-motive force of the machine, since this electromotive force is itself a function of the power of the inductors. If the arc is made shorter, the reverse phenomenon results. This is a poor condition of regulation, since the increase of power of the machine corresponds to a shortening of the arc, and inversely, the diminution of the electro-motive force, corresponds to the lengthening of the arc. The production of the machine is, then in a contrary direction to the needs of the arc, and it is certainly one of the great reasons for which this mounting demands, in order to work well, sufficiently sensible regulators. They avoid this inconvenience by several methods.

The first consists of arranging the inductors *by derivation;* this arrangement, conceived by Wheatstone in 1866, has not yet received many practical applications. M. Siemens, of London, is studying it at the present time and we shall find, by and by, an application of it in Edison's machine.

The second method, universally employed in the machines with alternative currents and which is commencing to spread in somewhat important applications where the lights have continuous currents, consists of charging the inductors of a series of machines by a special machine. Diagram 2 represents this arrangement. The arcs 1, 2,

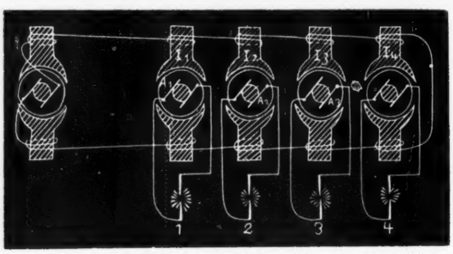


FIG. 2.—MACHINES charged by a special machine. Four machines with continuous currents supplying four regulators with a voltaic arc. The inductors are supplied by a separate generator.

3, 4 are bound to the brooms of the inducted bobbins A_1, A_2, A_3, &c., of the respective machines.

By this means a constant magnetic field is assured, whose power depends only on the velocity of the generator; as a result, the electro-motive force is then absolutely independent of the variations of resistance of the voltaic arc which it sustains. Thus is found the advantage of the magneto-electric machines whose magnetic field is constant, but we gain the additional advantage of having the most powerful machines, and of being able to vary the production of these machines by regulating at will the rapidity of the generator. There is in the French section a series of machines, arranged according to this principle.

Such are the arrangements employed with the *monophote* apparatus.

When a single machine is to supply several lights the arrangements change, and the lamps can be grouped in different ways.

When they are all branched over two general conductors starting from the limits of the machine, the lights are said to be established in *derivation*, in *multiple* or in *quantity* (fig. 3). When the lights are arranged, one

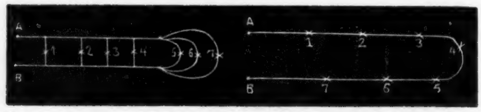


FIG. 3.—Mounting in derivation, in multiple arc, or in quantity.

following the other, on one and the same conductor, they are said to be mounted in *tension*, in *series*, or in *circuit* (fig. 4).

The mounting in multiple arc requires volume, that in circuit requires especially pressure or tension. The one or the other is applied according to the case.

Sometimes even several *derivations* are established, each carrying two, three, ten, etc., lamps in *circuit*. It is the case, for example, of the lamps of the Swan system of incandescence, fed by Brush machines.

The reasons of these multiple combinations are easy to comprehend. If the electric source of the machine we are arranging has more electro-motive force than that exacted by a single light, it would be an advantage to group several lights on the same circuit; when, on the contrary, the volume of current which the machine can produce is greater than that which is necessitated by a single light, we arrange them in *quantity* or in *derivation*. The Edison and Maxim systems of incandescence are monted in quantity over the source. They differ only, leaving on one side for a moment the lamp itself, in the manner of regulating the current.

In the Maxim system, the mounting of which is represented in figure 5, a separate generator supplies a series

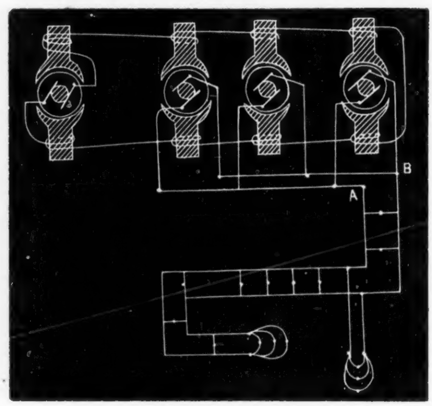


FIG. 5.—Mounting of the Maxim machines.

of machines, whose brooms are set between them in quantity, that is to say, by poles of the same name. All the lamps are branched over the conductors in derivation. The regulating obtains, by charging *automatically* the setting of the brooms of the generator, which reacts on the power of the current of the generator, and, consequently, on that of the inductor.

In the Edison system, the lamps are also mounted in derivation, but the inductors II^1 (fig. 6) are placed on a derived circuit led to the brooms of the machine in B and B^1. The power of the inductors is regulated, and consequently that of the machine, by manœuvring by hand a rheostat which serves to increase or diminish the resistance of the generating current, and consequently the electro-motive force of the machine. It is the Wheatstone mounting.

Machines with Alternative Currents.—The employment of alternative currents steps in with electric candles, because the two carbons must be equally consumed. Certain regulators also act with the alternative currents. The equal consuming of the carbon limits the displacement of the luminous point, which is often an advantage. All

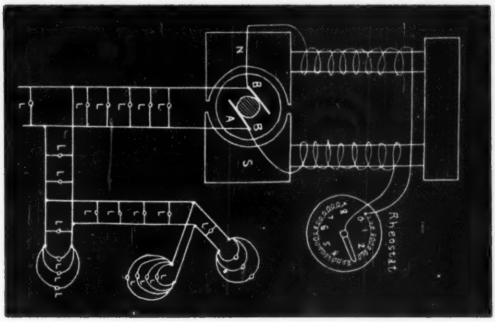


FIG. 6.—Mounting of the Edison machine.

the lights with alternate currents produce a peculiar humming owing to the nature of the currents which traverse them; this humming is often sufficient to forbid their use in places where it is necessary to have comparative silence.

The ensemble of a system of lighting by dynamo-electric machines, with alternative currents always includes two distinct machines: a machine with continuous currents or *generator*, and a machine with alternate currents, or *distributor*. This distributor consists of a variable number of circuits. Figure 8, simplified to show the

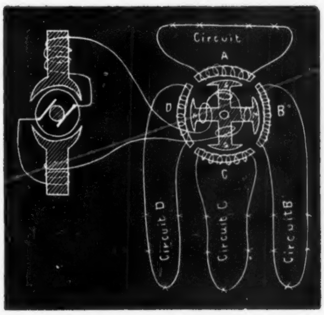


FIG. 8.—Mounting of a machine with alternate currents for candles.

principle, represents the mounting of a Gramme machine with alternative currents, supplying twenty Jablochkoff candles, arranged on four circuits of five candles each. The *movable* inductor bears eight poles, the successive ones with contrary names, in place of four. The generator can be of any system, whatever; it is only necessary to have a continuous current.

The power is regulated by the reciprocal velocities of the generator and the distributor. Sometimes the two machines mounted on the same axis turn with the same velocity, forming in reality but one. These machines are *self-generators*. In this case, we can no longer regulate the generator by its velocity, since this velocity is conjointly acting with the distributor; the regulating is then effected by the resistances introduced in the generating circuit. We have supposed the inducted bobbins *fixed* and the inductors *movable*. It is the case with the Lontin, Gramme, and Lambotte-Lachaussée machines. At other times, as in the Wilde and Siemens machines with alternate currents, the inducted bobbin is movable and the inductors fixed, but nothing is changed for this in the general principle. We see from these several examples that the art of the engineer allied with the science of the experimentalist, offers some resources to convert mechanical energy into electric energy and then to distribute it to the lights which utilize it.

MICROSCOPISTS.

The first meeting of the State Microscopical Society of Illinois, for the present season was held at the rooms of the Society, in the Academy of Sciences, Friday evening October 14, the President, Dr. Lester Curtis in the chair.

After the transaction of routine business, Mr. Stuart described the microscopical structure of some vegetable drugs. The subject is not suitable for abstraction, and requires illustrations to be useful.

His paper was followed by one by Dr. Curtis, describing a new stand made for him by Bulloch. This stand presented some novel features, among the most striking was a mechanical stage of extreme thinness, admitting light at an angle of 160°. The movements were effected by a double pinion above the stage, an arrangement pronounced by those familiar with the operation of the contrivance, as exceedingly useful and convenient.

The stand excited considerable interest, as did also a right angled camera lucida of German manufacture which was adapted to it, the superiority of which over the ordinary form was so marked as to be unmistakable on trying it, even under the disadvantages of a crowded room and constant jar. After a discussion of the papers, the meeting adjourned.

E. B. STUART.
Secretary pro tem.

PERMANGANATE OF POTASH USED AS AN ANTIDOTE TO THE POISON OF SERPENTS.

Very interesting experiments have been made in Brazil, by M. de Lacerda, which have established the fact that permanganate of potash is one of the most energetic antidotes to the venom of snakes. M. de Lacerda has addressed a memorial of his important works to the Academy of Sciences (meeting of the 12th of September, 1881).

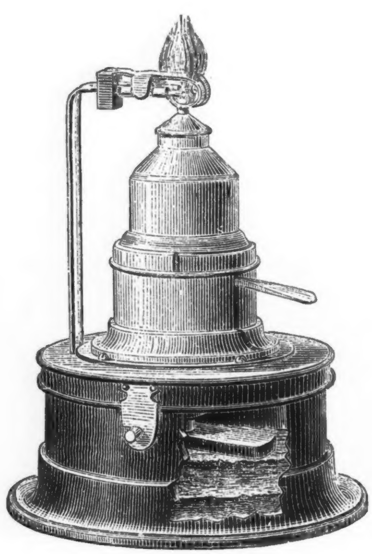
The result of these researches is really astonishing; thus in a series of experiments, frequently renewed, of injecting the active venom of *boshrops*, diluted with distilled water, in the cellular tissues, or the veins of dogs, M. de Lacerda found that the permanganate of potash was able *to stop completely the manifestation of local injuries from the venom.* Yet the same poison, which had served for these experiments, being injected without antidote into other dogs, always produced great local tumefactions, with loss of substance and destruction of tissue.

These very remarkable results have been stated on various occasions, not only by the Emperor of Brazil, who assisted at these experiments, but also by physicians, professors of faculties, and members of the diplomatic corps.

MEANS OF DETECTING THE SOPHISTICATIONS OF OLIVE OIL WITH OTHER OILS.—The oils employed at Marseille for the adulteration of olive oil are the oils of colza, sesame, cotton, and earth-nuts, Colza oil is detected by means of the sulphur which it contains; 10 grms. of the sample are saponified in a glass capsule with an alcoholic solution of caustic alkali free from sulphides. The mixture is stirred with a silver spoon, and if this is blackened, colza, or at least some cruciferous, oil is present. For the detection of the oil of sesame a little sugar is added to hydrochloric acid at 30° (Baume?) which is then mixed with an equal bulk of the oil in question. The mixture is well shaken up, and the least traces of oil of sesame are indicated by a red coloration. For the detection of cotton-seed oil there is added to the sample an equal volume of nitric acid at 40°. On stirring the mixture takes a coffee color. The detection of oil of earth-nuts is less simple. The sample is saponified with an alcoholic solution of potash, the soap separated as completely as possible, heated to expel the alcohol, and treated with enough hydrochloric acid to neutralize the alkali. The supernatant fatty acid—arachidic acid—is collected and dissolved in boiling alcohol, from which it separates in a characteristic white nacreous form.

ELECTRIC LIGHTER OF M. DESRUELLES.

This is a small apparatus, simple and practical, which will certainly be very highly appreciated by smokers and, in general, by all persons who are often in need of fire or light. It is one of the most direct applications of the drying of piles of all the systems by the process of M. Desruelles. This process consists of introducing in the piles, in the place of liquid, a kind of amianthus sponge that is afterwards filled with acid or some suitable solution. We thus gain by having a pile *dry* to some degree, which can be removed, displaced, or reversed without the liquid pouring out; this has its advantage for movable machines, such as portable lamps, piles for bells on board of ships, railroads, etc. The introduction of this inert substance diminishes the volume of the liquid; without saying that the electromotive force of the pile is not at all affected, its interior resistance is increased. This is of no importance in the case which we are now considing. The lamp consists of a small round box of wood, in which the pile is placed; over this box is placed a small lamp with oil; a platinum spiral in juxtaposition to the wick serves to produce the light.



The pile is an element to the bichromate of potash, in which the liquid is replaced by a kind of amianthus saturated with a bichromatic solution similar to that of the pile jar.

The zinc is hung from a small lever which it is only necessary to touch lightly in order to bring the zinc in contact with the sponge; the circuit is then formed, the zinc is attacked, and the current produced traverses the spiral, which reddens and inflames the oil. The pile once charged will serve for several hundred lightings. When the spiral no longer becomes red hot, the sponge must be replaced—a very simple operation. When the small lever is not pressed upon, the zinc is raised and kept thus from the action of the liquid which the sponge of amianthus absorbs. M. Desruelles constructed on the same principle a lighter to gas burners, in which the pile is placed at the extremity of an arm which is long or short, according to the height of the burner. This small domestic apparatus can be seen at the Electrical Exposition, where ts practical working is shown.

INTERNATIONAL CONGRESS OF ELECTRICIANS.—Professor G. F. Barker, in a letter to the *American Journal of Science* says:

The exhibition as a whole has been a decided success. It has brought together an immense mass of highly interesting material. There are in all something over 1500 exhibitors, of which one half are French, 155 Belgian, 115 English, 114 German, 81 Italian, 72 American, 39 Austrian, 32 Russian, 21 Swedish, 13 Swiss, 17 Spanish, 13 Norwegian, 11 Dutch, 5 Danish, and 2 Japanese. Of decided novelties, there are more in the United States section than in any other. Edison has made a wonderful exhibition of his inventions, and his rooms are thronged continually. The principle discovered by him that an electric current varies friction, the so-called motograph principle, together with the applications of it practically, are beautifully illustrated. The principle of the varying resistance of bodies which imperfectly conduct, whenthey are subjected to pressure, a principle which he was the first to investigate and to apply, is exhibited in a large series of instruments, one set of which traces the progress of development of the carbon telephone. The system of incandescent lighting which he has perfected is shown in all its details, from the unique dynamo machine of low resistance and high electromotive force, the street conductors with their connections, safety-catches, expansion-caps, etc., the ingenious meter and the house conductors with their incombustible covering, to the fixtures with double conductors and safety catches, and lastly to the incandescent lamp itself. Dolbear exhibits a new electro-static telephone which performs admirably and which consists simply of two thin metal plates, connected to the secondary wire by an induction coil. They are oppositely charged by the coil and so attract each other. Gray's harmonic multiple telegraph is in successful operation and Bell's original photophone is also exhibited. The most original thing exhibited in the French section is the secondary battery: Planté exhibits several forms of it, Faure shows the improvement which he made by covering the plates with minium, and lastly Meritens is working a still newer form, in which only lead plates are used, but a large number of them are put in a small space. In the historical line the collection in the exhibition is unrivaled. The pile of Volta, the electroscopes of Galvani, the thermopiles of Nobili and Melloni, the electro-magnetic induction ring of Faraday, the first magneto-machine of Pixii, the rheostats and telegraphs of Wheatstone, the telegraphs of Sœmmering, of Steinheil and of Gauss and Weber, the continuous current-machine of Pacinotti, the electro-thermic and electro-motor apparatus of Becquerel, the electro-capillary apparatus of Lippmann; all these and many more are here collected. And as for arc lights, the exhibition at night is like day. The Brush machine and light are in great favor. A large lamp of this sort just put up has carbons two inches in diameter, and is claimed to give a light of 80,000 candles.

BOOKS RECEIVED.

A TREATISE ON THE METHOD OF GOVERNMENT SURVEY, with complete Mathematical, Astronomical and Practical Instructions. By SHOBAL V. CLEVENGER. Second Edition, revised. D. Van Nostrand, 23 Murray street, New York.

This excellent treatise will be found of the greatest value to all engaged in government land surveying, and appears to surpass all its predecessors in its completeness and adaptability for practical work. Dr. Clevenger is one of our most esteemed contributors, and our readers are aware of the thorough nature of all literary productions which proceed from his pen. The present treatise on government land survey is exhaustive of the subject, and has been accepted by the highest authorities as an authoritive manual.

SATELLITES OF MARS.

DATA FOR EPHEMERIDES OF THE SATELLITES OF MARS IN THE OPPOSITION OF 1881.

By Professor Asaph Hall.

Greenw. M. Noon. Date.	Log f	F	Log g	G	Phobos u_1	Deimos u_2	Aberr.
		° ′		° ′	°	°	m
1881 Nov. 16.0	9.97946	296 3.7	9.50991	318 56.7	308.50	234.01	−5.9
18.0	9.97948	296 2.8	9.50901	318 41.0	46.18	84.34	5.8
20.0	9.97942	296 5.3	9.50858	318 22.0	143.86	294.67	5.7
22.0	9.97928	296 11.2	9.50865	318 0.1	241.54	144.99	5.7
24.0	9.97907	296 20.4	9.50923	317 34.9	339.22	355.32	5.6
26.0	9.97877	296 33.0	9.51037	317 7.2	76.90	205.65	5.5
28.0	9.97839	296 49.1	9.51205	316 36.8	174.58	55.97	5.4
30.0	9.97792	297 8.6	9.51431	316 4.3	272.26	266.30	5.4
Dec. 2.0	9.97738	297 31.4	9.51715	315 30.0	10.95	116.63	5.3
4.0	9.97674	297 57.6	9.52055	314 54.3	107.63	326.95	5.3
6.0	9.97603	298 27.1	9.52456	314 17.8	205.31	177.28	5.2
8.0	9.97523	298 59.7	9.52910	313 41.0	302.99	27.61	5.2
10.0	9.97435	299 35.4	9.53418	313 4.3	40.67	237.93	5.1
12.0	9.97340	300 14.0	9.53976	312 28.5	138.35	88.26	5.1
14.0	9.97236	300 55.3	9.54578	311 54.0	236.03	298.58	5.0
16.0	9.97125	301 39.0	9.55218	311 21.3	333.71	148.91	5.0
18.0	9.97008	302 24.8	9.55890	310 51.0	71.40	359.24	5.0
20.0	9.96886	303 12.4	9.56587	310 23.2	169.08	209.56	5.0
22.0	9.96759	304 1.5	9.57298	309 58.4	266.76	59.89	5.0
24.0	9.96629	304 51.6	9.58016	309 36.7	4.44	270.21	5.0
26.0	9.96496	305 42.2	9.58733	309 18.1	102.12	120.54	5.0
28.0	9.96363	306 33.0	9.59441	309 2.9	199.80	330.87	5.0
30.0	9.96230	307 23.4	9.60131	308 50.6	297.48	181.19	5.1
1882 Jan. 1.0	9.96099	308 13.2	9.60800	308 41.3	35.16	31.52	5.1
3.0	9.95971	309 1.8	9.61440	308 34.6	132.84	241.84	5.1
5.0	9.95847	309 48.8	9.62047	308 30.5	230.52	92.17	5.2
7.0	9.95728	310 34.0	9.62618	308 28.5	328.21	302.50	5.2
9.0	9.95614	311 16.9	9.63149	308 28.5	65.89	152.83	5.3
11.0	9.95508	311 57.3	9.63639	308 30.0	163.57	3.15	5.4
13.0	9.95410	312 34.8	9.64084	308 32.6	261.25	213.47	−5.5

The angle of position and the distance of the satellite, p and s, will be computed by the formulæ

$$s \sin p = \frac{a}{\rho} f \sin (F + u)$$

$$s \cos p = \frac{a}{\rho} \cdot g \sin (G + u),$$

where ρ is geocentric distance of Mars. The values of a, and of μ, the mean distances and the mean daily motions of the satellites are as follows:

Phobos.	Deimos.
$a = 12''9531$	$a = 32''3541$
$\mu = 1128^\circ 8405$	$\mu = 285^\circ 1632$

The quantity u for each satellite is given for the corresponding dates in the columns u_1 and u_2. For elongations the value of u is given by the equation

$$\text{tang } 2u = -\frac{f^2 \sin 2F + g^2 \sin 2G}{f^2 \cos 2F + g^2 \cos 2G}.$$

Thus for Dec. 20, $u = 325^\circ 83$ at the elongation, and in the case of Deimos $s = 53.7$. Near the conjunctions this satellite passes within $2''5$ of the centre of the planet, and the apparent ellipse will be very eccentric. Calling the brightness of the satellites unity on October 1, 1877, the brightness of the next opposition will be as follows:

1881 Nov. 16 brightness = 0.303
Dec. 14 " = 0.399
1882 Jan. 13 " = 0.330

The brightness of the satellites on November 16 will be a little greater than when they were last observed with the 15-inch refractor of the Harvard College Observatory.

On account of the greater distances of the planet from the Earth and Sun, these satellites will be faint next December, but as the planet will be in declination + 26°, they will be within the reach of several large telescopes, and it is possible that a good series of observations may be obtained. The elongation will occur in the angles of position 68° and 248° nearly, and the satellites should be looked for carefully at such times.

After the next opposition I hope to unite the observations of 1877, 1879 and 1881 in a new determination of the orbtis.

U. S. Naval Observatory, Washington, *June* 22, 1881.

The absorption of ultra-violet rays by certain media is being investigated by M. De Chardonnet. One method adopted is to direct a beam through a liquid in a trough with parallel glass or quartz sides, to Poitevin's photochromic paper (which indicates by change of tint, the presence of actinic rays). In a second method, a solar beam from a heliostat is sent through a slit, an objective of quartz and Iceland spar, and a prism of the spar, to a photographic plate or fluorescent screen; then a trough half filled with liquid is put before the slit. The author finds that the liquid circulating in plants, or impregnating roots and fruits have all an avidity for chemical rays. Fluorescence does not seem to be directly related to intensity of actinic absorption; thus decoction of radish absorbs less than decoction of potatoes, yet the former is without the property, while the latter is not. White wine is weakly fluorescent; red wine does not fluoresce. Of the few animal liquids examined, blood is found a powerful absorbent; but the aqueous humour of a calf's eye, and the albumen of eggs, have no action on chemical rays. Distilled water, alcohol, sulphuric ether, collodion, and solution of cane sugar are also inactive. Gelatine intercepts all the chemical rays, and it is sensibly fluorescent.

A PAPER on the "Electrical Resistance and the Coefficient of Expansion of Incandescent Platinum," by E. L. Nichols, Ph.D., was read at the Cincinnati Meeting of the American Association for the Advancement of Science, August, 1881, fully reported in *Amer. Jour. Science*, November. In his discussion of the subject, the author after showing the discrepancies in the formulæ of resistances as obtained by Siemens, Benoit, Matthiesen, and other physicists, draws the following conclusions: —

1st. The formulæ in question are based for the most part upon unwarrantable suppositions, such as the constancy of the specific heat of copper and of platinum; the constancy of the coefficient of expansion of the latter metal, and upon the accuracy of certain very doubtful values for the boiling points of zinc, cadmium, etc.

2d. That, aside from the inaccuracy of those data, the varying resistance of different specimens of platinum renders any formula for the calculation of temperature of that metal from its electric resistance applicable only to the identical wire for which the law of change of resistance with the temperature has been determined.

3d. That from the data at command we are not in position to calculate the temperature of an incandescent platinum wire from its change of resistance, nor from its length, nor indeed in any other manner, further than to express the temperature in terms of the length or the resistance of the wire.

4th. That, owing to the great variations shown by different specimens of platinum as regards its resistance, the determination of the expansion of the wire is to be preferred, whenever practicable, to the measurement of its conductivity.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

To the Editor of "SCIENCE."

Dr. Rogers seems again to misunderstand. It was not his quotation from Faraday that, was objected to, but the use apparently made of it to support his strange "questioning of the dogma that 'gravity acts in versely as the square of the distance,' on the ground that if that force is weakened by the earth's being removed to aphelion, it could not again bring back the body to perihelion." Any attempt to sustain that position by the authority of Faraday must certainly be a failure. Your correspondent seems not to distinguish between the definition of the force of gravitation, to which Faraday pertinently objected, and the law of gravitating action to which I particularly referred, and concerning which Faraday says, in the sentence immediately preceding that quoted by your correspondent, "It will not be imagined for a moment that I am opposed to what may be called the law of gravitating action, that is, the law by which all the known effects of gravity are governed:"—the very "dogma" your correspondent assumed to question!

GEO. B. MERRIMAN.

November 2, 1881.

METEOROLOGICAL REPORT FOR NEW YORK CITY FOR THE WEEK ENDING NOV. 5, 1881.

Latitude 40° 45′ 58″ N.; Longitude 73° 57′ 58″ W.; height of instruments above the ground, 53 feet; above the sea, 97 feet; by self-recording instruments.

OCTOBER AND NOVEMBER.	BAROMETER.					THERMOMETERS.											
	MEAN FOR THE DAY.	MAXIMUM.		MINIMUM.		MEAN.		MAXIMUM.				MINIMUM.				MAXI'M
	Reduced to Freezing.	Reduced to Freezing.	Time.	Reduced to Freezing.	Time.	Dry Bulb.	Wet Bulb.	Dry Bulb.	Time.	Wet Bulb.	Time.	Dry Bulb.	Time.	Wet Bulb.	Time.	In Sun.
Sunday, 30	29.893	29.910	0 a. m.	29.826	12 p. m.	66.7	64.0	70	12 m.	65	12 m.	62	0 a. m.	61	0 a. m.	125.
Monday, 31	29.750	29.826	0 a. m.	29.702	3 p. m.	67.0	64.7	69	2 p. m.	66	2 p. m.	62	12 p. m.	62	12 p. m.	74.
Tuesday, 1	29.846	29.918	12 p. m.	29.750	0 a. m.	58.3	56.6	62	0 a. m.	62	0 a. m.	55	12 p. m.	54	12 p. m.	64.
Wednesday, 2	29.949	29.992	9 a. m.	29.798	12 p. m.	55.6	55.3	57	1 p. m.	57	9 p. m.	53	7 a. m.	53	7 a. m.	66.
Thursday, 3	29.591	29.798	0 a. m.	29.446	12 p. m.	56.6	56.3	61	11 a. m.	60	11 a. m.	47	12 p. m.	47	12 p. m.	71.
Friday, 4	29.586	29.850	12 p. m.	29.446	0 a. m.	41.0	39.0	47	0 a. m.	47	0 a. m.	38	12 p. m.	37	12 p. m.	103.
Saturday, 5	29.990	30.062	9 a. m.	29.850	0 a. m.	48.3	45.6	56	4 p. m.	52	4 p. m.	36	5 a. m.	36	5 a. m.	104.

Mean for the week .... 29.800 inches.
Maximum for the week at 9 a. m., Nov. 5th .... 30.062 "
Minimum " at 12 p. m., Nov. 3d .... 29.446 "
Range .... .616 "

		Dry.			Wet.	
Mean for the week		56.2	degrees		54.5	degrees.
Maximum for the week	at 12 m. 30th	70.	"	at 2 pm 31st,	66.	"
Minimum "	" 5 am. 5th	36.	"	at 5 am 5th,	36.	"
Range "	"	34.	"		30.	"

OCTOBER AND NOVEMBER.	WIND.						HYGROMETER.						CLOUDS.			RAIN AND SNOW				OZONE.
	DIRECTION.			VELOCITY IN MILES.	FORCE IN LBS. PER SQR. FEET.		FORCE OF VAPOR.			RELATIVE HUMIDITY.			CLEAR, 0 OVERCAST. 10			DEPTH OF RAIN AND SNOW IN INCHES.				
	7 a. m.	2 p. m.	9 p. m.	Distance for the Day.	Max.	Time.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m	2 p. m.	9 p. m.	Time of Beginning.	Time of Ending.	Duration. h. m.	Amount of water	0 10
Sunday, 30.	w. n. w.	s. w.	s. s. w.	106	3	9.10pm	.512	.564	.577	94	79	84	9 cu.	8 cu.	10	0 am 4.45pm	4.30 am 12 pm	4.30 7.15	.09 .02	-- 0
Monday, 31.	s. w.	s. w.	e. n. e.	147	8	10.15 am	.577	.599	.562	84	84	94	10	10	10	0 am 9 am	4.30 am 12 pm	4.30 15.00	.17 .14	-- 0
Tuesday, 1.	n. e.	n. e.	n. e.	215	5¾	7.50 am	.487	.422	.407	94	87	87	10	9 cu.	6 cu.	0 am	8 am	8.00	.07	5
Wednesday, 2.	n. n. e.	e. n. e.	e. s. e.	150	1¾	10.00 am	.403	.436	.466	100	93	100	9 cu.	10	10	-----	----	-----	--	0
Thursday, 3.	s. e.	w.	n. w.	104	6¾	9.15pm	.466	.487	.403	100	94	100	10	9 cu.	10	3 am 8.30 am	8 am 12 pm	5.00 3.30	.05 .18	-- 10
Friday, 4.	w. n. w.	w. n. w.	w.	374	22¾	6.40 pm	.248	.195	.194	100	67	81	8 cu.	9 cu.	0	0 am	6.30 am	6.30	.29	0
Saturday, 5.	w.	s.	s. s. w.	230	7	10.30pm	.220	.282	.335	100	67	80	3cir.cu.s	3 cir.	0	-----	-----	-----	--	0

Distance traveled during the week .... 1,326 miles.
Maximum force .... 22¾ lbs.

Total amount of water for the week .... 1.01 inch.
Duration of rain .... 2 days, 6 hours, 15 minutes.

DANIEL DRAPER, Ph. D.

Director Meteorological Observatory of the Department of Public Parks, New York.